

Device for storing and reproducing audio and/or video

The invention relates to a device for storing and reproducing audio and/or video data, the device including a semiconductor memory for storing the data in digital form.

Audio and video data are increasingly stored and processed in digital form in view of the attainable advantages in quality. Typically, the audio and video data are then stored in optical or magnetic storage media such as, for example, CDs, DVDs or video cassettes. The data can be retrieved and can be reproduced acoustically or optically by loading the storage medium into a suitable playback apparatus, for example a CD player.

A further technical advantage of the digitally encoded audio and video data is that they can readily be copied without loss of quality. Economically this copying facility poses a substantial problem because it enables unauthorized copies to be made, which is a copyright infringement.

For this reasons methods have been developed to protect digital information against unauthorized copying. Thus, WO 97/04412 describes a method of protecting publicly distributed software, in accordance with which a loadable program is divided into two parts.

15 One of the parts is stored in a hardware key and must be reloaded into volatile memories (RAM) each time that the program is run. Consequently, the program can be used only when access to the hardware key is possible. Yet, this method, which is primarily intended for loadable programs, can be evaded when the software part stored in the hardware key is copied to a permanent memory at the user.

20 A method of protecting CDs or Mini Discs is described in WO 99/45539. A CD or a Mini Disc is then provided with a recordable area, in which a code that unambiguously identifies the playing apparatus is recorded when the medium is played for the first time by the playing apparatus. Thus, it is achieved that in the future the medium can be reproduced only by the individual playing apparatus. A disadvantage of this is that, on the
25 one hand, the high technical complexity, which requires special adaptations of the storage media and of the storage media, and, on the other hand, the undue limitation of the legal use of the storage medium to playing in a single reproducing apparatus.

WO 97/25675 describes a method and a device allowing computer software to be run on a CPU in a protected manner and a fee to be charged in accordance with the utilization time.

Furthermore, apparatuses are known which store audio and/or video data in a semiconductor memory and retrieve said data for reproduction on a suitable apparatus. The advent of compression standards such as MP3 (MPEG layer 3) for audio data and MPEG1, 2 and 4 for video data has resulted in an increasing use of semiconductor memories because the compression enables large amounts of data to be reduced to easier to handle sizes. In the known playing apparatuses the audio and/or video data are digitally stored in semiconductor memories, from which they are retrieved in digital form in order to be reproduced by means of loudspeakers or headphones and monitors, respectively, via appropriate devices such as decoding units, digital-to-analog converters, amplifiers and the like. The drawback of these apparatuses is that the user can access the audio and/or video data in digital form, which leads to the aforementioned possibilities of illegal copying and distribution of said data. Moreover, the reproducing apparatuses should comply with a given technical standard as regards the coding, as a result of which they have to be adapted upon each technical modification or they cannot take advantage of such modifications.

In this context it is an object of the invention to provide a device for the storage and reproduction of digital audio and/or video data, in which the digital information can always be stored in technologically optimum formats and is protected to a high degree against illegal copying.

This object is achieved by means of a device as defined in claim 1. Advantageous embodiments are defined in the subclaims.

The device for the storage and reproduction of audio and/or video data accordingly includes a semiconductor memory for the storage of the audio and/or video data in digital form. It is characterized in that it includes a conversion unit which converts the digital audio and/or video data into signals suitable for reproduction units, and in that the output lines of the device, on which the useful signals are made available, issue from the conversion unit.

Thus, the invention makes use of the advantages of the digitization of audio and/or video data, i.e. in particular the cost-effective and high-quality digital storage of said data in a semiconductor memory. Storage can then be effected during the manufacture of the device or also subsequently via an external digital write access. However, in contradistinction to the known apparatuses the device does not allow the user to access the data in their

original digital form because the output lines of the device, from which the externally accessible useful signals can be taken, issue from a conversion unit in which the digital data have been converted previously. Thus, in the device in accordance with the invention a part of the processing of the digital data, which processing is necessary for the reproduction of the audio and/or video information by a loudspeaker or a monitor, is performed directly upon retrieval of the data from the semiconductor memory.

The conversion unit of the device may include a decoder with logic means for carrying out different tasks. The tasks may include in particular the encoding and the decoding and/or the compression and decompression of the digital audio and/or video data.

Further processing steps are the amplification and/or the voltage supply. The use of a semiconductor memory for the storage of the digital audio and/or video data has the advantage that the retrieval of said data and their processing can be effected by purely electronic means. Thus, in contrast with a CD player or a cassette apparatus, it does have any movable mechanical parts, which would limit the shock resistance of the apparatus and which would lead to a high power consumption. The combination of stored data with logic processing means further has the advantage that during the manufacture of the device always the latest processing and storage technology can be used because for the reproducing apparatus merely the format of the useful signals should remain the same. Internally, the storage medium can therefore always be provided with the latest encoding/decoding and compression/decompression technologies, without the user having to purchase a new reproducing apparatus for this technical upgrade.

The conversion unit of the device in accordance with the invention may further include a digital-to-analog converter, which converts the digital audio and/or video data into analog signals. The analog signals made available by the device may be, for example, line-out signals for audio or RGB signals for video, which are further processed by appropriate reproduction units and which can, for example, be reproduced by a loudspeaker after intermediate amplification. Since in the device in accordance with the invention a part of the necessary data processing is integrated in the storage medium for the data the data are no longer accessible in digital form for the normal user. This precludes easy copying of the data without loss of quality, as a result of which unauthorized copying of the audio and/or video data is substantially impossible.

Preferably, the device is integrated on a single microchip. This means that this microchip incorporates, on the one hand, the semiconductor memory cells for the storage of the audio and/or video data and, on the other hand, the necessary logic means for processing

The device preferably takes the form of a chip card, i.e. as a microchip incorporated in a plastic card having the customary credit-card size. Such an embodiment of the device, which functions as an intelligent storage medium for audio and/or video data, has several advantages. On the one hand, the device thus has a certain minimum size, as a result of which it is easier to handle and a tangible product similar to a CD or a disc record is made available to the customer. Furthermore, such a device is flexible and can therefore be integrated in, for example, clothing. Finally, there are reliable methods of disposing of plastic chip cards, which is of particular interest for audio and/or video data having a short period of use, for example for test data, tourist information and the like.

Moreover, the conversion unit of the device can be configured in predetermined types, configuration being effected only subject to authorization control and/or in irreversible form. This means that configuration of the conversion unit requires the possession of a given access key (authorization control) and/or that once configuration has taken place it cannot be cancelled. As a result of such a configurability of the conversion unit it is possible that a customer can purchase the device in technically different and differently priced configurations, the relevant configuration being determined by an authorized seller upon the purchase. Configuration can be effected, for example, in that certain parts of the circuits in the conversion unit are disabled so as to tailor it to the customer's ideas about features and quality.

The device in accordance with the invention can be used, for example, for the storage of audio data in the MP3 (MPEG Layer 3) format. These data are stored in digital form in the semiconductor memory on a chip. The same chip may further include an MP3 decoder, which converts the data into digital audio data. The chip may also include a D/A converter, on whose outputs analog useful signals appear. These signals can be reproduced via an amplifier and a reproduction unit. Moreover, the amplifier and a limited energy storage means may be integrated in the device, so that only headphones or the like are required in order to use the device.

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with reference to the drawing. In the drawing:

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integrated;

digital-to-analog converter is integrated.

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amplifier 6 and an loudspeaker 7.

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with the latest storage and compression technology without another reproducing device 2' being needed for this reason.

In the system shown in Fig. 3 even a further relocation of components to the medium 1" has been effected, the digital-to-analog converter 5 being also accommodated in the medium 1". As a result, only analog signals are now externally available from the medium 1", which provides complete protection against making digital copies. At the same time, the advantages of the configuration shown in Fig. 2 are obtained, i.e. the possibility to use the latest encoding and decoding techniques in the medium 1".

The embodiments shown in Figs. 2 and 3 can be extended inter alia in that the medium 1' or 1" is provided with a unidirectional digital input. This enables digital data in encoded form to be stored in the semiconductor memory 3, as a result of which a recordable medium is obtained. However, the reproduction of the data then remains possible only via the decoder 4, i.e. in decoded form, which precludes further copying of the content of the semiconductor memory 3.

Moreover, the decoder 4 is preferably adapted to process commands from the user and/or the system, such as for example "play", "stop", "pause", "next item" etc. In order to make this possible a communication protocol is required between the medium 1' or 1" and the reproducing device 2' or 2", which may be unidirectional in the simplest case. Suitably, a bidirectional protocol is provided, allowing status information to be transmitted from the medium to the reproducing device.

Legend:

1, 1', 1" storage medium

2, 2', 2" reproducing device

3 semiconductor memory

4 decoder

5 digital-to-analog converter

6 amplifier

7 loudspeaker